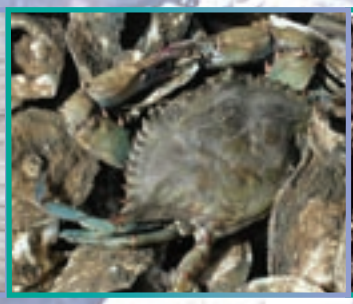
Virginia Oyster Gardening



This guide was written and produced by Laura McKay and Virginia Witmer of the Virginia Coastal Zone Management Program based largely on a document written in 1999 by Mark Luckenbach, Francis O'Beirn and Jake Taylor of the Virginia Institute of Marine Science: "An Introduction to Culturing Oysters in Virginia". Our thanks to Mark for letting us "recycle" that text and for helping to structure this new version. Thanks to Jackie Partin and Chan Chandler of the Tidewater Oyster Gardeners Association, Jim Wesson of the Virginia Marine Resources Commission, Laurie Carroll Sorabella of Oyster Reef Keepers and Lynnhaven 2007 and Chris Moore and Amy Blow of the Chesapeake Bay Foundation for their guidance and input on this document. Thanks also to Rachel Bullene of the Virginia CZM Program staff and to our summer intern, Lauren Harris, for their help in researching and compiling information.

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Virginia Coastal Zone
MANAGEMENT PROGRAM

NOAA

William & Mary VIMS
Virginia Institute of Marine Science
School of Marine Science

Virginia Marine Resources Commission

Virginia Oyster Reef Heritage Foundation

TOGA
TIDEWATER OYSTER GARDENERS ASSOCIATION

Printed on recycled paper.

Visit us on the Web at: www.deq.virginia.gov/coastal/

Welcome to Oyster Gardening!

Thank you for starting your own oyster garden!

We hope this oyster gardening guide will help you learn how to grow oysters in the most efficient way possible while gaining an understanding of the challenges that the once plentiful oyster now faces due to disease and predators.

The information is as up to date as possible, but as new information becomes available, please check the Web sites listed at the end of the guide for the most current information. This this guide is also available on the Web at www.deq.virginia.gov/coastal/ and this Web version will be updated as needed.

We hope that through oyster gardening you will become a proponent for restoration efforts to help increase oyster populations and improve Virginia's coastal waters. We also hope that you will encourage others to take up this hobby. Remember even if you don't own waterfront property, your friends, neighbors, employers, schools, local parks and businesses might - and you could be the one to get them hooked on oyster gardening.

Have Fun!

IN THIS GUIDE

Oyster Gardening Can Help Virginia's Coast!

Whether you are planning to grow oysters for your own consumption, for donation to sanctuary oyster reefs or for some other reason, your efforts can help in improving water quality and biodiversity along our coast.

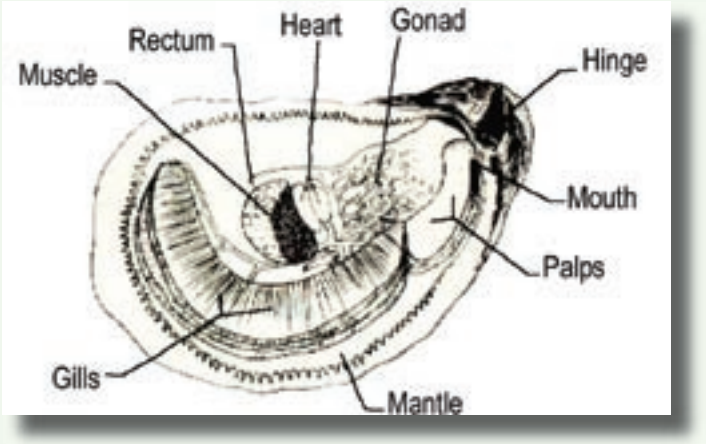
And that is no small gesture! As Virginia's population continues to increase (we are the 5th fastest growing state in the country), it becomes more and more difficult to deal with the increased amounts of sewage, fertilizer, car emissions, and other pollutants associated with our human activities.

Human sewage, waste from pets and livestock, fertilizers, and car emissions all contribute huge quantities of nitrogen to our coastal waters. Too much nitrogen causes algae blooms, turning the water a greenish hue and preventing sunlight from reaching precious underwater grass beds.

When this algae dies, decomposing organisms experience a population boom. Because the decomposers are oxygen breathing, their sudden increase in numbers pulls huge amounts of oxygen out of the water creating a condition called anoxia. Anoxia causes our valued finfish and shellfish to die. So the end result of excessive nitrogen in our coastal waters is dead finfish and shellfish and the loss of critical underwater habitats.

Here's how oyster gardening helps…

There are already over 2,000 oyster gardeners "cultivating" Virginia waters. But we need many, more! Growing oysters helps to improve water quality because each adult oyster filters up to 50 gallons of water per day when water temperatures are above 50 degrees. They are filtering particles out of the water, including algae and sediment. They do this by beating the cilia on their gills and drawing water in at a rate of 2-3 gallons per hour. The food particles, caught in mucous strings on their gills, are passed around the gills to the palps where the oyster sorts food from non-food. If the particle is food (algae), it ingests it. If the particle is non-food (e.g. sediment), the oyster excretes it as "psuedo-feces" which fall to the bottom. So the oyster is effectively pulling algae and fine sediment out of the water column, clarifying it.



Clear water is needed in order for underwater grass beds, rooted to the bottom, to grow. Underwater grass beds, or SAV (submerged aquatic vegetation) is essential habitat for other finfish and shellfish and also supports ducks and other animals. In addition to performing the Herculean task of cleaning the water and enabling the growth of seagrass habitats, natural oyster reefs provide habitat to a tremendous number and variety of other finfish and shellfish.

Photo courtesy of CBF.

Why are so few wild oysters left?

Based on historical accounts, three-dimensional oyster reefs were once a prominent feature of Virginia's coast. Captain John Smith reported in the early 1600's that you could practically walk across the James River on the tops of oyster reefs. During the Civil War, oyster reefs were so large that they were a danger to navigation in the Chesapeake Bay. And In the early 1900's Diamond Jim Brady was said to have eaten over 100 oysters in one sitting. At times in the past Virginia was producing 7-8 million bushels of oysters a year with approximately 20 million bushels harvested Bay-wide.

Recently the oyster harvest has been as small as 20,000 bushels. The dramatic crash of the oyster' population occurred because of harvesting, habitat destruction and two diseases. These diseases, commonly called MSX and Dermo, are caused by protozoan parasites and were first identified in the mid-Atlantic in the 1950's. Dermo is a disease that is native to Chesapeake Bay and usually kills oysters in their 2nd or 3rd year. MSX was introduced into the region in the 1950's when someone attempted to introduce a non-native oyster. Due to these diseases, continued heavy harvesting, and decreased water quality, we now have only about 2% of the oyster population that existed here as recently as the 1950's.

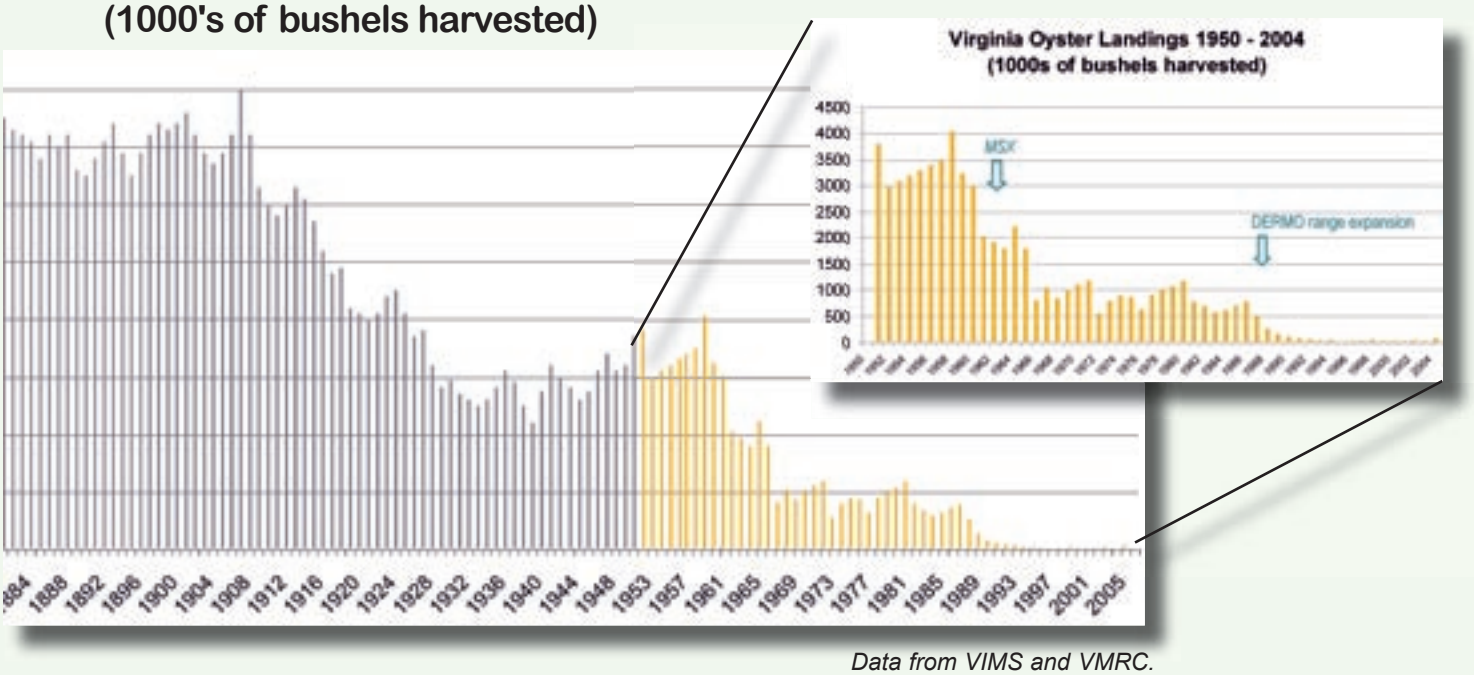
See Reference A on page 17 for more information on oyster diseases and breeding for resistance.

Culturing oysters can increase our native population.

Commercial oyster aquaculture and private oyster gardening are two promising ways in which we can increase our native oyster population. For many years resource managers and scientists have been trying various techniques to culture oysters for commercial purposes and to restore wild oysters in Virginia. This work has included development of disease tolerant strains of oysters, construction of small-scale and large scale reefs using a variety of settlement substrates, and even the testing of non-native species of oysters. In 1999 the Virginia Coastal Zone Management Program brought together VMRC, VIMS, NOAA, ACOE and others to form the Virginia Oyster Heritage Program to bring attention and funding to the issue of oyster restoration. Much work remains to be done and success with wild oyster restoration has been limited so far.

So as restoration of wild oysters and vast expanses of oyster reefs continues to elude us, we look to commercial cultivation and oyster gardening as one way of increasing our native oyster population. Virginia's seafood industry is struggling and our coastal waters are in dire need of cleaning. And while most of our efforts need to be focused on reducing the land-based sources of nitrogen such as human sewage, waste from pets and livestock, fertilizers, and car emissions, it would certainly help to have more oysters filtering all that algae that results from the excess nitrogen. The cumulative impact of thousands of people growing oysters could be quite significant!

Virginia Oyster Landings 1880-2004
(1000's of bushels harvested)



Data from VIMS and VMRC.

How to Start and Maintain an Oyster Garden

Step One: Evaluate the Site

Will your site support growth?

The first two things you need to know are whether the location you have chosen for your oyster garden will actually support oyster growth, and whether you will be able to eat the oysters grown at that site. An oyster garden needs to be located where you have 4 basic things:

- **the correct range of water salinity**
- **a minimum water depth**
- **adequate amounts of oxygen to breathe**
- **adequate amounts of plankton to eat**

Salinity

Oyster growth rates are dependent upon salinity. Salinity is measured in grams of salt per liter of water, or parts per thousand (ppt or ‰). Oysters require a salinity of at least 8 ppt to grow and oyster growth increases with increased salinity. Below 10 ppt salinities, oyster growth rates are generally reduced; some oysters show intermediate growth rates at salinities between 10 – 20 ppt and highest growth rates at high salinities. This may be a function of heritage and oyster seed may be bred for selected salinity in the near future. You can test your water salinity using a simple device known as a hydrometer. Hydrometers may be found easily at pet stores. The map on the opposite page shows the general areas where salinity supports oyster growth.

Another important consideration about salinity is its relationship to oyster diseases. At low salinities (below 10 ppt), MSX (Haplosporidium nelsoni) does not persist; and, while Dermo (Perkinsus marinus) can survive at these salinities, it does not cause mortality. Raising oysters throughout the entire growing cycle in low salinity can be an effective means of avoiding disease, but it results in a very watery tasting and slow-growing oyster. Generally these are not desirable traits. In addition, oysters grown at some low salinity sites are at risk of mortality from “freshets.” These are sudden influxes of fresh water due to a heavy rainfall.

Water depth

For two reasons your site must have a minimum water depth of one foot, even at the lowest tide:1) oysters can only filter water and grow when they are submerged - so they will grow faster if they are always under water; 2) in the winter, when tides and winds may cause your oysters to be exposed at low tide, your oysters may freeze. Oysters can be frozen solid in the water and survive, but they will die if exposed to sub freezing air temperatures.

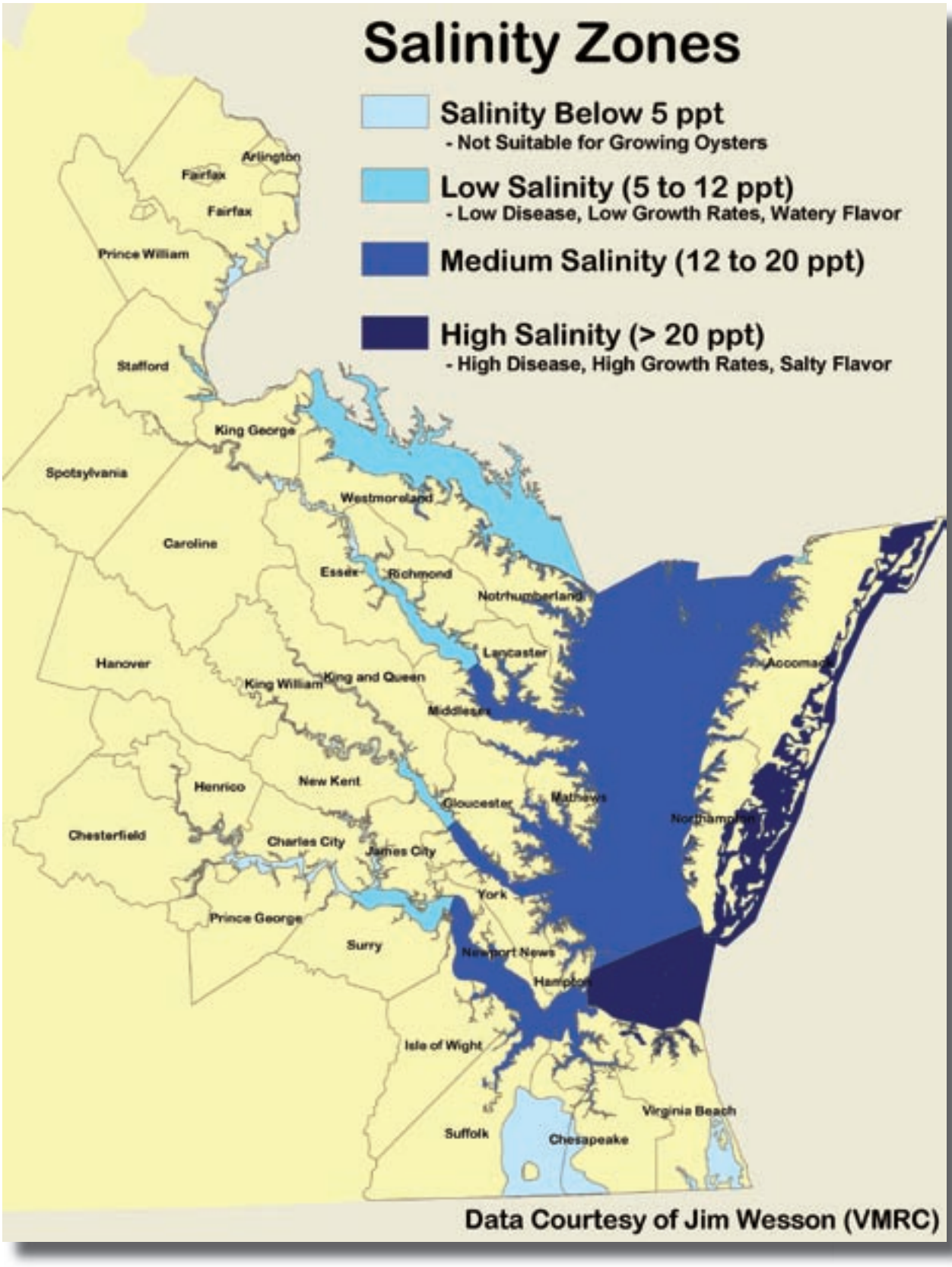
Dissolved oxygen

Oysters need dissolved oxygen levels in the water of at least 3.2 milligrams per liter, but 5.5 mg/l or more is best for survival and growth. Colder water can hold more oxygen than warmer water. That’s why we often hear of “anoxia events,” (low oxygen situations) in the summer. Generally Virginia’s coastal waters have sufficient oxygen to support oysters grown close to the shore and off the bottom. If you are concerned about oxygen levels, you can measure dissolved oxygen using a field kit.

Plankton

The quantity and quality of food available to oysters can vary considerably from location to location. The quantity and quality are a function of the hydrodynamics at a site (how the water is moving through the site) as well as the abundance of phytoplankton in the water. If you have access to more than one site, you may want to experiment with the different areas to see which produces the biggest oysters. If you have only one location, you may have to evaluate different seed stocks and handling strategies in order to maximize oyster growth and survival.

Photo courtesy of Virginia CZM Program.


Salinity Zones
Salinity Below 5 ppt
- Not Suitable for Growing Oysters
Low Salinity (5 to 12 ppt)
- Low Disease, Low Growth Rates, Watery Flavor
Medium Salinity (12 to 20 ppt)
High Salinity (> 20 ppt)
- High Disease, High Growth Rates, Salty Flavor
Arlington
Fairfax
Fairfax
Prince William
Stafford
King George
Spotsylvania
Westmoreland
Caroline
Essex
Richmond
Northumberland
Lancaster
Hanover
King William
King and Queen
Middlesex
Henrico
New Kent
Gloucester
Mathews
Northampton
Chesterfield
Charles City
James City
York
Prince George
Surry
Newport News
Hampton
Isle of Wight
Virginia Beach
Suffolk
Chesapeake
Data Courtesy of Jim Wesson (VMRC)

How to Start and Maintain an Oyster Garden

Step One: Continued

Will it be safe to eat oysters grown at your site?

Not all gardeners choose to eat their oysters, but if you do, you must determine whether they are safe to eat. To answer this, visit the Virginia Department of Health's online maps of condemned shellfish areas: *www.vdh.state.va.us/OEHS/Shellfish/index.asp*. VDH's Division of Shellfish Sanitation tries to minimize the risk to humans of disease from shellfish by classifying shellfish waters for safe commercial and recreational harvest.

Because oysters feed by pumping water through their gills and filtering out their microscopic food particles, they may also ingest bacteria and viruses that are in the water. And because oysters, including their intestinal tracts, may be eaten raw, care must be taken to ensure that oysters harvested for consumption are taken from very clean water. Waters approved for harvest of shellfish must be much cleaner than waters approved for swimming and fin-fishing.

VDH determines the safety of waters for shellfish harvest by conducting shoreline surveys and taking fecal coliform samples from the water. The shoreline surveys note the presence of actual and potential sources of pollution. Of primary concern is the presence of fresh human and animal fecal matter. All onsite sewage facilities are investigated to see if they are functioning properly, and all other potential sources of pollution including animal waste, toxic substances, industrial discharges, marinas, wastewater treatment facilities, etc. are inspected. Sewered areas are noted, but not investigated.

The field data and other pertinent information are compiled into a report accompanied by a map of the area. The map shows which properties were inspected and which had an actual or potential pollution source found onsite. The final report and map are sent to the locality and the state agencies responsible for the problems found. VDH investigates about 13,000 properties per year, and conducts new shoreline surveys every 6 to 8 years.

VDH/DSS maintains boats at each of its field offices and collects and analyzes fecal coliform samples monthly at designated stations throughout shellfish growing waters in tidal rivers, Chesapeake Bay and the Seaside of Virginia's Eastern Shore. DSS collects and analyzes about 24,000 seawater samples per year.

See "Step Seven: Harvest" on page 16 for more information on safety and eating oysters. *Photo courtesy of CBF.*

Some Oyster Facts

The ancient Romans served large quantities of oysters at their banquets, learned to cultivate them, and even made a monetary unit, the denarius, equal in value to one oyster.

Oysters are scientifically classified as molluscs, a word from the Latin meaning soft.

While the power of the adductor muscle varies with the size and condition of the oyster, it takes a pull of over 20 lb suddenly applied, to open the shell of a 3 to 4-inch American oyster in good condition.

There is no way of telling male oysters from females by examining their shells. While oysters have separate sexes, they may change sex one or more times during their life span.

When water chills, oysters cease to feed. The oysters stop filtering and seldom open their shells. However, unlike hibernating bears and other animals which live on stored fat, they show very little weight loss after the winter's sleep.

How to Start and Maintain an Oyster Garden

Step Two: Choose a Growing Strategy

Should you start in the spring or the fall?

You can begin growing your oysters in the fall (September - November) or the spring (March - May). Oysters in Virginia generally experience the greatest growth and disease exposure from June through August.

When you start your oysters will determine how many times they are exposed to disease. For example, June through early September is the time in Virginia when new infections of Dermo generally occur and existing infections intensify. By waiting until fall to start your garden you can avoid exposure to Dermo during the early stage of oyster growth and limit your oysters to a single disease exposure period (the following summer) during the culture cycle. This level of exposure to Dermo is generally not sufficient to cause mortality in hardy oyster stocks.

Over the past 15-20 years scientists have advocated a strategy whereby oyster gardeners buy "fall seed." This strategy maximizes the number of growing seasons prior to reaching two disease exposure seasons (see Box 1).

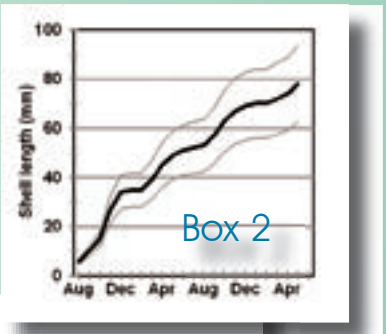
The use of fall seed normally results in very rapid growth during the first fall season (see Box 2). Failure to achieve growth in this time period results in small oysters (less than 35 mm). Entering the winter months, oysters of this size have a reduced likelihood of reaching harvestable size prior to succumbing to disease.

But there are alternative approaches. Spring seed, spawned as early as March, has successfully been used by many growers. While this approach provides for fewer growing seasons prior to two disease exposure seasons (see Box 1), it does help you to avoid the risks of entering the winter with small oysters.

This strategy has worked at sites with very high growth rates, such as the high salinity environments of the Atlantic side of the Eastern Shore, and can result in growth to harvest size in 14 months or less. Further, some individuals have had success growing oysters which were spawned during May or June and placed in the field during July.

Successful use of summer seed seems to require a culture site with only modest disease exposure risk. For the oyster gardener, it is most important to ensure that the seed you purchase is disease free at the time of the purchase, and that it was produced from the best available brood stocks.

A final aspect of managing disease by timing techniques is to harvest oysters before they enter their second summer, when Dermo infections are likely to intensify, and the oysters succumb to the disease. It may be more gratifying to eat a 2½ inch oyster in April than to wait a few months for it to grow larger and lose it to disease.



Box 2

Box 1

Fall Seed

1st Fall (good growth) → 1st Winter (poor growth) → 1st Spring (good growth) → 1st Summer (poor growth **disease exposure**) → 2nd Fall (good growth) → 2nd Winter (poor growth) → 2nd Spring (good growth) → 2nd Summer (poor growth **disease exposure**)

Harvest → *Harvest*

Spring Seed

1st Spring (good growth) → 1st Summer (poor growth **disease exposure**) → 1st Fall (good growth) → 1st Winter (poor growth) → 2nd Spring (good growth) → 2nd Summer (poor growth **disease exposure**)

Harvest

How to Start and Maintain an Oyster Garden

Step Three: Choose a Containment System

A wide range of options is available for maintaining oysters off the bottom. Methods include the use of floats, suspended mesh bags and fixed bottom racks or cages. No single method is right for everyone, and no single method guarantees success. Each grower must consider characteristics of the growing site and his or her ability to handle the weight of the containers. Several options are offered here and a number of different modifications of these systems may be commercially available. See pages 9 and 21 for more information and contacts. Oyster gardeners have been quite inventive in devising containers and methods that work for them. You should feel free to experiment with modifications and methods to make gardening easier for you, given your particular site. The important thing to remember is that your system must provide:

1) adequate predator protection,
2) minimal flow obstruction, and
3) ease of maintenance and handling.

Taylor float

Taylor floats can be attached to lines so they can be hauled more easily onto a dock or pier for maintenance. Photo by Kathy Hoffman.

The Taylor float (named after its designer, Jake Taylor) is a containment system that holds oysters about one foot under the surface of the water. The Taylor Float has a sturdy, relatively open design that provides limited surface area for fouling and permits good water flow. Disadvantages include the cumbersome size (some are as large as 2' x 8') and the possible need for a hoist to retrieve the floats when they are full of oysters. A 2' x3' Taylor float will hold about 500 adult oysters. Taylor floats can be tied under a dock or pier which keeps them out of the sun and helps slow the accumulation of algae on the float and the oysters.

Taylor floats are generally constructed with a 2' x 3' frame of 4 inch PVC pipe and a one inch by one inch mesh marine plastic coated wire basket. Plastic coated wire is best for reducing corrosion and extending the life of the float. ½ " plastic mesh bags holding smaller oysters are laid into the float and can be turned over every couple of weeks. As the size of the oysters increases, the mesh size of the bags should also be increased and the densities of oysters reduced.

For extra protection against predators, a ½ inch mesh liner made of thin plastic (often sold as bird netting to protect fruit trees) may be placed within the float and attached to it with cable ties. For a 2' X 3' Taylor float, cut 3 ft x 4 ft sections and secure it to the inside of the float. The liner should extend 6 inches up the sides of the float and be secured at the top with the cable ties. The liner may protect against predators, but may slow water flow through the float.

Larger oysters can be placed directly into the floats, but the float may need a lid to keep out predators. Lid options for this float include ¼ inch thick plywood lids, wire mesh, and shade cloth. Performance of different lid options varies with location, and opinions about the best type of lid vary among oyster gardeners. Lids can restrict the growth of macro algae in the floats and reduce predation by otters and seagulls. However, barnacle and oyster settlement may be greater on lids, and seagulls roosting on top of the lids may cause elevated fecal coliform bacteria levels.

The Tidewater Oyster Gardeners Association holds workshops each year at which gardeners are taught to build their own float. (Directions for building the float may be found at *www.oystergardener.org*.)

Gardeners devise ways of lifting floats up to the dock for cleaning and maintenance. Small cranes, boat lifts, even jet-ski lifts may be adapted for this purpose. Photo courtesy of TOGA.

Mesh bags

A less expensive oyster garden, illustrated in the photo below, consists of ADPI marine plastic mesh bags, each containing about 150 oysters. The bags are kept afloat by four, empty, one-liter soda bottles. Multiple bags are lined up with a rope running through the middle of each bag and attached at each end to a piling or stake. Running a rope through the middle of the bags allows them to be flipped end to end every week or so, to help keep them clean. Fouling organisms tend to grow on the bottom side, so when the bags are flipped, that side is exposed to sun and air which will kill off most of the fouling organisms.

Gardeners in locations where the water may freeze in winter will need to sink the bags by filling the soda bottles with water, or by other means, to prevent freezing. The mesh bags may also be placed on racks constructed of steel reinforcing bar (rebar). This "rack and bag" method generally involves securing bags with oysters onto racks that extend 1 – 2 feet above the bottom. Bags may be purchased from commercial suppliers or made with 1/8", 3/16", and 5/8" mesh size openings. The bags are closed with 4 inch cable ties or using a combination of ½" stainless steel hog rings and cable ties.

Photos by courtesy of TOGA.

Cages

Bottom racks or cages are useful in places where the bottom is hard and wave action is too great for surface floats to work. They may also be preferred in shallow waters where aesthetics are a consideration and you don't want the oyster garden to be visible. These cages are commercially available or may be constructed. They sit on feet that are 8 inch to 12 inch high and must have a lid to protect oysters from predators. These cages full of adult oysters can be quite heavy, and this should be kept in mind when purchasing or building them.

Photo courtesy of TOGAby Preston Philyaw.

Photo courtesy of TOGA.

Small baskets (Australian cages), as in the photo above, are also commercially available. These hold around 100-150 mature oysters. They may be fastened to long lines, or suspended in the water by a PVC pipe sealed at both ends and hung from a dock. A distinct advantage of these cages is that they are not as heavy to lift out of the water to clean or maintain compared to those described above. On the other hand, they don't hold very many oysters.

How to Start and Maintain an Oyster Garden

Step Four: Get a Permit

It's important because...

Getting a permit for oyster gardening is a simple process, it's free, and it's for your own protection and benefit. The Virginia Marine Resources Commission issues oyster gardening permits. They have provided the simple application form on page 11 that you can cut out, fill out, and mail in to them.

This permit will authorize you to use state-owned waters near your property for the noncommercial culture of shellfish. In other words, it allows you to grow oysters in public waters for your own personal consumption or use, but it does not allow you to sell those oysters commercially. Selling oysters commercially requires other permits from VMRC and the Virginia Department of Health. VMRC does not currently apply size or season harvest regulations to cultured oysters grown for non-commercial purposes.

When you get a permit, you are on record at the VMRC as an aquaculture site. A record of permits with the locations of oyster gardens makes it possible to get a better estimate of how many cultured oysters are in state waters and what positive effect they may be having on water quality in various areas. So be sure your efforts are counted!

Another benefit of being a permit-holding gardener is that you now have an additional, publicly-recognized stake in the quality of the waters adjacent to your property. This could be an important factor for the VMRC when they are asked to consider issuing permits for other activities in your neighborhood which may conflict with your use of the state's waters. It could also allow the Virginia Department of Health to see where concentrations of oyster gardening are occurring and compare that to data on condemned shellfish areas and known sources of fecal coliform contamination so that your health can be better protected.

By applying for a permit which VMRC reviews and approves, you also ensure that your oyster garden does not interfere with the public's right to navigate, nor with the growth and health of submerged aquatic vegetation (SAV). If SAV is present near your shoreline, it could be shaded by floats on the surface or damaged by cages placed on the bottom.

Photo courtesy of TOGA.

Here's how you do it...

Complete one signed original of the permit application form on the facing page if you plan to deploy up to 160 square feet of aquaculture structures in the tidal waters of Virginia for non-commercial purposes. Be sure to include the required drawings of your containment system and return it to VMRC at the address on the back side of the form. VMRC will forward copies of your application to your Local Wetlands Board and your Local Health Department for their review. The Health Department may contact you if your project is proposed to be conducted in polluted waters. You should receive notification of your permit approval from VMRC within a few weeks.

If you believe your project will cover more than 160 square feet, may impact navigation or SAV beds then you may need to complete the standard Joint Permit Application which you can obtain by calling VMRC at (757) 247-2252 or the US Army Corps of Engineers at (757) 201-7652. For more guidance on obtaining shellfish aquaculture permits, ask VMRC for a copy of "Guide to Virginia's Laws, Regulations & Requirements for Marine Shellfish Aquaculture Activities." This guide covers both commercial and non-commercial shellfish farming.

Abbreviated Joint Permit Application For Noncommercial Riparian Shellfish Aquaculture Structures - "Oyster Gardening"

1. Applicant's name and complete mailing address:

_____

_____

_____

Telephone numbers:
Home (____) _____
Work (____) _____

2. Physical address of the project site (if different from above):
Street address:_____

OR

Local Tax Map No.: _____

3. Waterbody at the project site:
a tributary to _____ in _____County/City

4. Please provide accurate directions to the project site from the nearest intersection of two state roads:

5. Description of the aquaculture structures to be employed:

Floats: Size (LxWxH in inches) _____ Number to be used_____

Bottom Cages: Size (LxWxH in inches) _____ Number to be used_____

Other structures: Please provide a description including the size and number to be used.

6. (A) Will the structures be secured to an existing private pier?
(B) If yes, will they extend beyond the end of the pier?
(C) If yes, how far channelward of the pier will they extend and what is the distance to the recognized channel? _____ feet. What is the width of the waterway at the project site (mean low water to mean low water)? _____ feet.

7. If you answered NO to question 6 (A) above, will they be located in the waters immediately opposite your shoreline? Describe how will the structures be secured.

Note: If new pilings are required to secure the structures, a standard permit may be required. Please call VMRC for details at (757) 247-2252.

Cut along the dotted line to submit application.

8. What is the Health Department's current classification of the growing waters at the project site?
Open for direct harvesting, Seasonally closed, Permanently closed, or Uncertain. (Circle one)

9. Please provide the following required drawings:

A. Vicinity Map - Use a map to depict the exact location of the project site. Please indicate the name of the map used. USGS quadrangle maps, street maps, or county maps are preferred.

B. Plan View Drawing - This drawing must depict the proposed structures as if viewed from above. The drawing must include, a north arrow, the waterway name, the location of mean high water and mean low water, the location of any submerged aquatic vegetation at the site, the width of the waterway, the direction of ebb and flood of the tide, your property lines and shoreline, the opposite shoreline if the waterway is less than 500 feet wide, the depth of water at the project site, and the location of the existing navigation channel. A recent plat of the property, if available, provides a good scaled template for the plan view drawing.

C. Cross Sectional Drawing - The cross sectional drawing must show the dimensions of the proposed structures as viewed from the side. It should include the depth of the water and any structures which will be used secure the floats or cages. If the application is for floats which will be secured to your existing pier, a cross sectional drawing will not be required.

ALL APPLICANTS MUST SIGN

I hereby apply for all necessary permits for the activities described herein. I agree to allow the duly authorized representatives of any regulatory or advisory agency to enter upon the premises of the project site at reasonable times to inspect and photograph site conditions.

I hereby certify that the information submitted in this application is true and accurate to the best of my knowledge.

_____ _____

APPLICANT'S SIGNATURE APPLICANT'S NAME (PRINTED/TYPED)

_____

DATE

IF DIFFERENT FROM APPLICANT:

_____ _____

PROPERTY OWNER'S SIGNATURE PROPERTY OWNER'S NAME (PRINTED/TYPED)

_____

DATE

Please mail your completed "Oyster Gardening" permit application to:

Virginia Marine Resources Commission
Habitat Management Division
2600 Washington Avenue, 3rd Floor
Newport News, Virginia 23607-0756

Thank You!

How to Start and Maintain an Oyster Garden

Step Five: Purchase Supplies

When buying seed, it's important for the oyster gardener to be sure that it comes from a hatchery that has the best available brood stocks. That means oysters with a proven record of good growth and survival in areas where disease is prevalent. While disease tolerant oyster lines have been developed, it is unlikely that a fully disease resistant oyster will ever be discovered.

A bag of 1000 oyster seed of varying sizes. Photo courtesy of TOGA.

Vendors for oyster seed and containment systems change frequently but you should be able to locate one close to you, no matter where you are in Virginia's coastal area. See Reference C on page 20 for Web site addresses for the Tidewater Oyster Gardeners' Association (TOGA) and the Chesapeake Bay Foundation (CBF). The Toga Web site gives you 14 vendors in Virginia and 1 in Rhode Island that can be viewed alphabetically or by location. TOGA's site also provides contact information for 70 Master Oyster Gardeners. You may want to contact an MOG near you for advice on the best seed and containment sources, as well as for advice on oyster gardening in general. The CBF Web site gives you 11 suppliers organized by geographic region within Virginia and two, out-of-state mail order suppliers.

What will it cost?

You could spend anywhere from $60 to $140 to start your garden. It all depends on the size of seed, the type of containment system you buy and how many oysters you want to grow. For the most up to date information and prices go to the Web sites listed on page 20 under "Lists of Oyster Gardening Suppliers."

A bag of 1000 seed oysters can cost from $25 - $60. The larger the seed you buy, the more expensive it will be. Some suppliers will even ship the seed to you.

Your containment system costs will probably be the more expensive part of your garden. On the high end of cost are prefabricated Taylor floats. They can run $80 to $115 for the 2'x3'x1' or the 4'x6'x1' floats. Plus, you will have to buy mesh bags for your small oysters. However, if you can build a float yourself, the Taylor float materials should only cost about $45-$50. But be careful to construct it properly so that it doesn't sink.

Cages cost from $30 to $45. In addition you will need to buy about 6 bags at $4-6 each. You will start your oysters in 2 of the bags and eventually move them into the other 4 bags as they grow. So if you start with 1000 seed oysters, you'll end up with about 250 oysters in each of the 4 larger bags.

Mesh bags may be the least expensive option. You can purchase them for $3.50 to $6.00 each. Or you can buy a $40 mesh bag kit with one bag having small mesh size for small seed oysters and 5 bags with large mesh size for use as your oysters grow. Each 2'x3' bag will hold 200 harvest-size oysters and you supply the 2 liter plastic bottles to use as floats.

It may cost more to produce oysters in your garden than to buy them at the store, but, don't forget you are adding filter feeders to Virginia's waters and you can go out and harvest your oysters whenever you like!

An assembled oyster cage. Photo courtesy of TOGA.

How to Start and Maintain an Oyster Garden

Step Six: Set Up and Maintain the Garden

Set Up

Most people find setting up and maintaining an oyster garden quite easy and enjoyable. By setting up your oysters in containment systems suspended above the bottom, both the quantity and quality of the food available to the oyster is improved and you've generally made life easier for them.

There are no strict guidelines regarding the best position in the water column to place the oysters. Often raising the oysters as little as 6 inches above the bottom is enough to reduce the amount of suspended sediments which they must filter and this improves their growth rates. Most people find it convenient to tie their containment systems to their dock as in the photos on pages 8 and 9. Keep in mind performance is very site specific and depends on water depth and food availability.

Placement of oysters in racks or bags in the intertidal zone can have advantages which include easy access to your oysters at low tide, fouling control, and predator protection. However, extended exposure out of the water reduces the feeding time available for oysters and reduces growth rates. If intertidal culture sites are used, oysters should be placed in the low intertidal area to reduce exposure to extremes of heat and cold.

The steps below are for growing oysters in a Taylor float. However, the basic approach can be adapted to mesh bags and cages.

1. Secure floats in the water with ropes or other means to keep them stationary. Try to place float(s) in a low wave action setting.

2. Place 20 mm seed oysters in 3/16" mesh bags at a density not exceeding 1000 oysters/bag in Taylor float. (Numbers will vary in other floats.) Remember – you may want to initiate this step in late September after the greatest threat of Dermo infection has passed.

3. After 2 - 6 weeks, depending upon growth rates, remove oysters from the small mesh size bag(s) and place them into larger mesh size bags. Alternatively, place the oysters into a float with ½" mesh lining. Densities within a 2 ft x 3 ft float should not exceed 1000 small or 500 market size oysters. Some growers prefer to keep oysters in 3/8" - 1/2" mesh bags throughout the growing cycle. If this is done, densities should be reduced to about 200 oysters/bag.

Maintain

Maintaining an oyster garden is a little like caring for a vegetable garden, although many find it easier. But like vegetable gardening, it's a good idea to stay on top of things and check on your oysters regularly.

The containment system should be cleaned periodically. The cleaning schedule will vary according to conditions in your area, but usually every 3-4 weeks in winter and every 2 weeks in summer is sufficient.

Fouling (growth of small organisms) on floats, bags, and oysters can be removed by washing with water (fresh or salt) and scrubbing with a stiff brush. High pressure washing is sometimes required to remove firmly attached organisms. Care must be taken not to damage small oysters when using high pressure washers. In some locations the settlement of barnacles, mussels, and even oysters onto the floats can be a particular problem, since these are not easily washed off.

Hydroids are colonial animals that can cover the surface of your oyster garden bag or float and reduce water flow into your garden. Remove this algae-like animal with freshwater and a brush, or allow your floats to air and then brush them off. Photo courtesy of VIMS.

Parasites, such as flatworms, can kill your oysters. If detected early enough, these animals can be removed using a **brine dip**. A brine dip should be used only with oysters greater than 10 mm. Smaller oysters will die from the procedure. Leave oysters (>10mm) out of the water for about one hour before dipping to ensure they are closed. Make a brine solution by dissolving 25 pounds of salt in 10 gallons of estuarine water (plastic trash cans work well). Leave oysters in the bags and dip and agitate each bag for five minutes. Leave the bags out of water for another hour or two then rinse them thoroughly before placing them back into the water. The amount of time that oysters should be left out of the water will depend upon their size and the weather conditions. If cleaning small oysters on a very hot day, the times given above should be reduced.

An alternative to the brine dip is to simply raise the bags above the low water mark so they are exposed to the sun at low tide. This method should also kill the

flatworms but not the oysters. Occasionally flipping the bags over in the water can also help to control fouling and improve water flow to the oysters. Make sure oysters are spread evenly in the bag, allowing all oysters space to feed and grow.

You may occasionally find dead oysters in your containment system. You should remove the dead oysters. However, clean, empty shells provide "nests" for beneficial small fish such as blennies and gobies so don't throw them out! One of the benefits of your oyster garden is the provision of habitat to other animals, so do what you can to help out the welcome visitors to your garden. See pages 18 and 19 to learn about the animals that will be attracted to your oyster garden.

If a storm is coming, be sure ropes are secure and your name and address are on your float. Use a waterproof sharpie marker. During more intense storms – hurricanes, tropical storms and northeasters – it is best to take your floats out of the water and store them in a safe, cool and dry place. The oysters will be fine out of the water for 1-2 days. The larger the oyster, the greater its ability to withstand being out of the water.

School Children Growing Oysters

Teachers are showing students that they CAN make a difference in our environment. Each year, Oyster Reef Keepers of Virginia provides schools in coastal Virginia with the opportunity to participate in a student oyster restoration program called "Schools Restoring Oysters to the Chesapeake." This program engages 7,250 students from 145 K-12 grade classes each year in a Bay-wide effort to restore the oyster population. As of 2005, 48,500 students have contributed a remarkable 2.7 million oysters to sanctuary reefs in Virginia. This project takes a hands-on approach to education, allows students to execute authentic science, is based on scientifically sound restoration strategies, and meets multiple Virginia Standards of Learning.

Students transplanting oysters. Photo courtesy of ORK.

Each September, classes receive 2,000 baby oysters from ORKV and deploy them in Taylor Floats in near their school, where the oysters are grown out. Each month, students visit their oysters and measure their growth rates and mortality and monitor the water chemistry. They clean and maintain their oysters and containers, and identify natural and human-induced actions that may impact oysters and water quality. At the end of the school year, classes transplant their oysters onto sanctuary reefs where their oysters will spawn and provide offspring to revitalize future oyster generations.

By growing and transplanting oysters, students gain knowledge of ecology, oyster biology, and water quality. They also get a chance to take part in authentic scientific research and learn field sampling techniques. In addition to academic skills, students gain a connection to our coast and an empowering sense that they have the ability to improve it.

Oyster Reef Keepers of Virginia provides teachers with a training workshop, oysters, water chemistry equipment, a Taylor Float, and classroom curricula and teaching resources, all for $90. Teachers interested in joining the program should contact Laurie Carroll Sorabella at Oyster Reef Keepers of Virginia via e-mail (oysterreefkeeper@yahoo.com) or telephone (757-460-1200), or visit our upcoming web site www.oysterreefkeepers.org.

How to Start and Maintain an Oyster Garden

Step Seven: Harvest Time!

To eat or to donate?

With luck and a "Blue Thumb," you should have oysters ready for harvest within 12 months (fall of the second year). Of course, like any form of gardening, you should expect some mortalities and will probably not be able to grow all of the seed you purchased to the peak, 2 ½ - 3 inch size. Oysters should be removed from the containment systems at this size so that any remaining, smaller oysters will have less competition for food.

Below are some considerations to guide you whether you choose to eat your oysters, donate them to a sanctuary reef, or simply release them to public waters. No matter what your choice, you can be proud of your accomplishment in raising your oysters and providing a small "cleaning" service to Virginia's coastal waters and "housing" service to other small marine creatures needing places to feed, hide and "nest."

Eating your oysters

For the gardener, the size at which you eat the oysters is up to you since regulations limiting harvest size for wild stocks do not pertain to cultured oysters in Virginia. Rapidly grown oysters tend to have thin shells and a high meat content, so that should make them easy to open and tasty.

Eating raw oysters (and other raw, molluscan shellfish) can cause illness or even death due to Vibrio and other bacteria. Unfortunately, the addition of hot sauce or alcohol does not kill Vibrio. However eating thoroughly cooked shellfish does not usually pose a health risk. Different kinds of Vibrio are found naturally in coastal waters and are not a result of pollution, and so may be found even in waters approved for oyster and clam harvesting. The risk of ingesting Vibrio is higher in the warm summer months.

One particular kind of Vibrio bacteria (Vibrio vulnificus), can cause serious illness or death for people considered high risk, including those with liver disease, diabetes, stomach disorders, cancer, or any illness or medical treatment which results in a compromised immune system.

Symptoms of illness from Vibrio include vomiting, diarrhea, stomach pains, severe weakness, skin rashes, blisters, chills and high fever. Infection also can occur when cuts, burns or sores are exposed to seawater containing Vibrio bacteria. If you get a cut or wound while in the water, clean the wound with soap and water or a disinfectant, such as hydrogen peroxide. If you see signs of infection (redness or swelling) or have any of the above symptoms after ingesting raw oysters, see your doctor. For more information on Vibrio, go to the Center for Disease Control Web site at www.cdc.gov/ncidod/dbmd/diseaseinfo/vibriovulnificus_g.htm.

Donating your oysters

In some areas you can donate your oysters to sanctuary reefs where the oysters cannot be harvested and are left to serve as brood stock and provide habitat for other marine creatures. The Chesapeake Bay Foundation holds annual "Oyster Round-Ups" where you can donate your oysters at various locations throughout Virginia from mid-July through mid-September. CBF asks that you pre-register for the Round-Ups (see pages 20-21 for contact information).

Another option, if you have hard, sandy bottom nearby, is to place your large oysters on the bottom. Eventually you may be able to build an oyster reef. You could put your clean, empty shell on the bottom as well. Huge oyster reefs along many of Virginia's shorelines used to provide protection from erosion by breaking the wave energy before it hit the shore. Unlike bulkheading to protect the shoreline from erosion, these reefs create a "living shoreline" where plants and animals can thrive. A living shoreline is of far greater ecological benefit than a bulkhead and under moderate to low wave energy conditions can provide the same protection from erosion.

Virginia CZM Program staff assisting the Chesapeake Bay Foundation in transplanting oysters to a Lynnhaven River sanctuary reef. The oysters were grown through the Foundation's oyster gardening program. Photo courtesy of the Virginia CZM Program.

Oyster Diseases and Resistance

REFERENCE A

Oyster diseases

MSX and Dermo are not caused by viruses, but rather by single-celled protozoa. Neither parasite is harmful to humans.

In the Chesapeake Bay, oysters become infected with **MSX** from mid-May through October. Infections develop rapidly in susceptible oysters and result in mortalities from July through October. Oysters that survive their first season may still harbor the parasite over the winter and succumb the following spring or early summer.

Temperature and salinity regulate MSX. Both parasite and oyster are inactive at temperatures <5°C (41°F). At 5-20°C (41-68°F), the parasite proliferates more rapidly than the oyster can control it. Above 20°C (68°F), resistant oysters can overcome the parasite while susceptible oysters are killed. A salinity of 10 ppt or below results in expulsion of the parasite at temperatures above 20°C. A salinity of 15 ppt is required for infection, 20 ppt is required for rapid and high mortality.

Fortunately, some oysters are resistant to MSX and this resistance is heritable. For several decades hatchery-based breeding programs have made use of this to selectively breed strains of oysters that are highly resistant to MSX. If you are growing oysters in waters where the salinity regularly exceeds 10 ppt, you should be sure to use one of these lines of oysters.

Dermo infections occur throughout the warm months, May through October, with maximum mortalities observed in September and October. Low numbers of parasites remain over the winter, and these parasites proliferate once temperatures increase in late spring. Infective stages of the parasite are released from infected and dying oysters, so it is imperative to avoid moving infected oysters into an area containing uninfected oysters.

Temperature and salinity greatly influence Dermo. The parasite proliferates and infections intensify above a threshold of 20°C (68°F). At temperatures above 25°C (77°F), the parasite rapidly multiplies, spreads, and kills oysters. Infections decline at temperatures below 15°C (59°F). Prevalence and infection intensities of Dermo increase with increasing salinity. High intensity infections and high mortalities often occur in areas with salinities above 12-15 ppt. Infection intensities remain low in areas with salinity consistently below 9 ppt.

Unfortunately, selective breeding has yet to produce a strain of oysters that is truly resistant to Dermo, though different strains do have varying degrees of tolerance to the parasite. When growing oysters at sites with salinities above 9 ppt it is important to use one of the selected strains that have been demonstrated to have some Dermo tolerance. The timing of planting your oyster seed can also affect their exposure to Dermo (see Page 6). Growing oysters rapidly and harvesting prior to a second summer of exposure to the disease can reduce mortality.

Creating a disease resistant oyster

Many hope that a disease resistant oyster will someday be available for aquaculture and restoration of wild stocks. Research related to this goal has followed three lines: (1) the search for natural strains of the native oyster which exhibit some disease tolerance; (2) selective breeding programs; and (3) investigations with non-indigenous oyster species.

Selective breeding is an ongoing process and as one generation of oysters has been distributed to hatcheries, another generation is being developed and tested. Selective breeding programs are, however, unlikely to develop the “perfect oyster” and diseases likely will remain a significant issue.

For more about these diseases visit the VIMS MSX and Dermo Fact Sheet at www.vims.edu/newsmedia/pdfs/oyster-diseases-CB.pdf.

Animals of the Oyster Garden

Neighbors...

Clam Worm

This harmless polychaete worm (*Nereis succinea*) is often seen crawling on top of cultured oysters. It is 1 - 3 cm in length and looks similar to a centipede.

Grass Shrimp

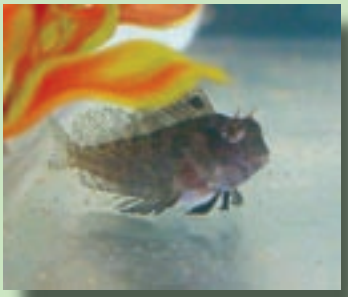
This shrimp (*Paleomonetes pugio and P. vulgaris*) is the most common organism associated with oyster floats.

The Grass shrimp does not pose a threat to oysters.

Periwinkle Snails

This snail (*Littorina littorea*) climbs up and down salt marsh grasses, where it feeds on small fouling organisms.

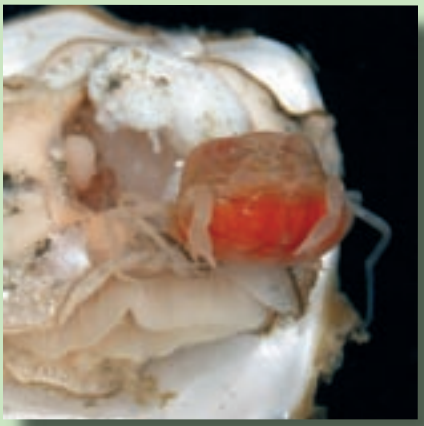
Adding a dozen or so periwinkles to your oyster garden will help keep it clean.



Blennies, Gobies and Skillet Fish

Small fish, like blennies, gobies and skilletfish, love to visit oyster gardens where they can hide from their predators. Blennies nest in empty oyster shell.

"Children love oyster gardening! Oysters attract a microcosm of aquatic life and teaching children about the ecology of oysters is one of the most gratifying aspects of oyster gardening." - Jackie Partin, Tidewater Oyster Gardeners Association.



Pea Crabs

These tiny crabs (*Zaops ostreum*) live inside the oyster, feeding on algae and often bits of the oyster gill, but they generally cause little harm to the oyster.

Hermit Crabs

Small, 1-2 cm, hermit crabs (genus *Pagurus*) are no threat to oysters and can help keep your garden clean of fouling organisms that obstruct water flow. Larger hermit crabs are capable of eating smaller oysters.

Mud Crab

Several species of mud crabs (*Panopeous* and related genera) are very common to the oyster garden.

This small crab may feed on your small oysters but is also in search of other prey such as Hermit crabs and Periwinkle snails.

Photo credits: Clam Worm & Pea Crab courtesy of Southeastern Regional Taxonomic Center/South Carolina Department of Natural Resources; Grass Shrimp courtesy of NOAA; Hermit Crabs, Striped Blennie, Barnacles, & Mussels by Tim George, Virginia Aquarium and Marine Science Center; Periwinkle Snail by Virginia Witmer; Mud Crab by K. Hill, Smithsonian Marine Station at Fort Pierce, FL; Blue Crab courtesy of Virginia Tidewater Oyster Gardeners Association; Boring Sponge, Mud Blister Worm and Flatworm courtesy of Virginia Institute of Marine Science.

Competitors...

Barnacles

These hard-shelled crustaceans that attach in large numbers and can compete with oysters for space and food. Barnacles can be eliminated by air exposure if identified early enough, but large individuals must be physically removed with a scraper. Careful! Barnacles are very sharp.

Mussels

Mussels (blue mussel, *Mytilus edulis*; ribbed mussel, *Guekensia demissa*; scorched mussel, *Brachiodontes* spp.) may settle in your garden. Blue mussels are the most common. They do not pose a threat unless abundant and then they compete with oysters for food. Remove them when small by scraping.

Sea Squirts

Sea Squirts or Grapes (*Molgula manhattensis*) are commonly found in higher salinity waters and may be controlled by scraping or aerial exposure for 1-2 hours.

Predators...

Blue Crab

(*Callinectes sapidus*) a voracious oyster predator, may settle in your garden mid to late summer, growing rapidly to a size capable of consuming your oysters. Regularly inspect floats and bags and remove any crabs.

Mud Blister Worm

(*Polydora webstri*) blisters shell (look for yellowish sores in the adductor muscle). Infection rarely causes death and oysters are edible, but blisters may interfere with shucking. Outbreaks may be reduced through a brine dip. See page 14 for details.

Boring Sponge

(*Cliona celata*) filter feeders that burrow into and weaken shell (watch for a series of holes with light yellow sponge tissue visible), usually affects 3-4 yr. old oysters in high (18+ppt) salinity. The sponge can generally be ignored, but severe infestation can make oysters unsightly and (rarely) cause mortality. A brine dip can control the sponge.

Flatworms

(*Stylocus ellipticus*) prey on small oysters in late spring or early summer. No larger than 25 mm, this worm is green, yellowish brown, or salmon colored. Flatworms can be devastating to a young oyster garden. The preferred treatment for flatworm is a brine dip. See page 14 for details.

Oyster Garden Websites and Contacts

Oyster Gardening Web sites:

Virginia Institute of Marine Science - www.vims.edu/abc/green/ogp.html

Chesapeake Bay Foundation - www.cbf.org/virginiaoysters/

Tidewater Oyster Gardening - www.www.oystergardener.org/

Lists of Oyster Gardening Suppliers:

Tidewater Oyster Gardeners Association - www.oystergardener.org/ (Click on “Oyster Gardening Resources)

Chesapeake Bay Foundation - www.cbf.org/virginiaoysters/ (Click on “Purchasing Oyster Gardening Supplies")

Oyster Restoration:

Virginia Oyster Heritage Program - www.deq.virginia.gov/oysters/

The Virginia Oyster Reef Restoration Map Atlas - www.vims.edu/mollusc/oyrestatlas/

NOAA Chesapeake Bay Office - http://noaa.chesapeakebay.net/OysterMain.aspx

Chesapeake Bay Program - www.chesapeakebay.net/baybio.htm

VA Institute of Marine Science Oyster Monitoring Program - www.vims.edu/mollusc/monrestoration/monoyster.htm

Oyster Reef Ecosystems:

Oyster Reef Communities in the Chesapeake Bay - CD-Rom - www.vims.edu/mollusc/education/orccb.html

Smithsonian Marine Station at Fort Pierce - www.sms.si.edu/irlspec/Oyster_reef.htm

Chesapeake Bay Program - www.chesapeakebay.net/american_oyster.htm

Teacher Resources:

Oyster Reef Keepers - www.oysterreefkeepers.org

Sea Grant Ocean Sciences Education/Bridge - www.vims.edu/bridge/index_archive0501.html
Information and lesson plans for grades 5 -12

VORTEX: Virginia’s Oyster Reef Teaching Experience: www.vims.edu/mollusc/education/vortex.html

Oyster Anatomy Laboratory - www.mdsg.umd.edu/oysters/anatlab/

Bivalve Anatomy: www.assateague.com/nt-bival.html

Oyster Disease Information and Research:

VIMS Oyster Disease Fact Sheet - www.vims.edu/newsmedia/images/oyster-diseases-CB.pdf

Disease Resistant Oyster Research - VIMS Aquaculture Genetics and Breeding Technology Center - www.vims.edu/abc/

Virginia Aquaculture:

Virginia Aquaculture Association - www.virginiaaquaculture.org

East Coast Shellfish Growers - www.ecsga.org

Eating Oysters:

Virginia Marine Products Board - www.virginiaseafood.org/ (Great Recipes!)

How to prepare and open oysters - www.hormel.com/templates/template.asp?catitemid=115&id=795

Permits

Virginia Marine Resources Commission (VMRC)

Habitat Management Division
Chip Neikirk
(757) 247-2200
chip.neikirk@mrc.virginia.gov

Conservation and Replenishment
James Wesson
(757) 247-2121
jim.wesson@mrc.virginia.gov

Water Quality

Virginia Department of Health
Division of Shellfish Sanitation
Robert Croonenberghs
(804) 864-7477
bob.croonenberghs@vdh.virginia.gov

Accomac Field Office:
Paul Widgen (757) 787-5847, paul.widgen@vdh.virginia.gov

Norfolk Field Office:
Timothy Fearington (757) 683-5847, tim.fearington@vdh.virginia.gov

Whitestone Field Office:
Carroll Vanlandingham (804) 435-1095 carroll.vanland@vdh.virginia.gov

Virginia Department of Environmental Quality
Water Quality Monitoring Data
Roger Stewart (804) 698-4449,
Roger.Stewart@deq.virginia.gov

Aquaculture Information

Virginia Department of Agriculture and Consumer Services (VDACS)
Aquaculture and Marine Resources
T. Robbins Buck (804) 371-6094, robins.buck@vdacs.virginia.gov

Virginia Marine Resource Commission (VMRC):
Saltwater Aquaculture
Lewis Gillingham (757) 247 -2243 2200 lewis.gillingham@mrc.virginia.gov

Extension Support

Virginia Institute of Marine Science (VIMS)
Sea Grant Advisory Services
Michael Oesterling, (804) 684-7165, mike@vims.edu

Oyster Gardening Organizations

Chesapeake Bay Foundation in Virginia (804) 780-1392
Virginia CBF Oyster Gardening Program
Chris Moore (757) 622-1964, cmoore@cbf.org

Tidewater Oyster Gardeners Association
Jackie Partin (804) 694-4407, hellneck@earthlink.net
TOGA's website: www.oystergardener.org

Northern Neck Oyster Gardeners
Don Beard (804) 438-4820

Lynnhaven 2007
Cliff Love (757) 481-6449, oystercom@hotmail.com

School Oyster Gardening

Oyster Reef Keepers
Laurie Carroll Sorabella, (757) 460-1200, oysterreefkeeper@yahoo.com

Mailing Addresses

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Richmond, Virginia 23219

Virginia Institute of Marine Science
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Rt. 1208 Great Road
Gloucester Point, Virginia 23062

Virginia Marine Resources Commission
Habitat Management Division
2600 Washington Avenue
Newport News, VA 23607
(804) 247- 2200

U.S. Army Corps of Engineers
Norfolk District
803 Front Street
Norfolk, Virginia 23510
(757)-441-7068

Cover Photos courtesy of the Tidewater Oyster Gardeners Association and the Chesapeake Bay Foundation.